

A narrative review of the epidemiology and economics of chronic wounds

N. Graves ¹, C.J. Phillips ² and K. Harding ³

¹Health Services and Systems Research, Duke-NUS Medical School, Singapore

²Department of Public Health and Policy Studies, Swansea University, Swansea, UK

³Clinical Innovation Hub, Cardiff University, Cardiff, UK

Summary

Correspondence

Nicholas Graves.

Email: n.graves@duke-nus.edu.sg

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Chronic wounds have a debilitating effect on the quality of life of many individuals, and the large economic impact on health system budgets warrants greater attention in policy making and condition management than is currently evident. The aim of this narrative review is to summarize the nature and extent of the chronic wound problem that confronts health systems across the world. The first section is used to highlight the underlying epidemiology relating to chronic wounds, while the second explores the economic costs associated with them and the relative efficiency of measures designed to manage them.

Introduction

Often disguised as a comorbid condition, chronic wounds have been described as a silent epidemic that affects a large fraction of the world's population. Chronic wounds have been defined as 'wounds that do not heal properly during an amount of time that normally should be sufficient for healing'.¹ While some studies have specified actual cut-off times for healing, in the range from 4 weeks up to more than 3 months,^{2–9} there is no consensus for the duration of chronicity, with authors advocating a need for further research in the area.^{10–12}

The lack of consensus on a definition has been a constraint on the effective management of chronic wounds, while also hampering comparisons between separate clinical retrospective or prospective studies.¹⁰ The basis for such a claim was that from 669 articles that had met the inclusion criteria for a systematic review,¹³ 68% of the articles did not provide a definition or a staging system, while only six articles provided any indication of duration for defining chronicity. While the articles examined were classified according to the causative aetiologies – pressure ulcers (PUs), diabetic ulcers, venous ulcers and arterial insufficiency ulcers – there were only 28 articles on chronic venous ulcers, which comprise the majority of

chronic wounds.¹⁴ Similarly, a comprehensive review of epidemiological evidence for the prevalence and incidence rates of chronic wounds revealed 854 studies, 69 of which met the selection criteria for inclusion. Of these studies, 42 were on PUs, 20 on diabetic ulcers, 10 on venous ulcers and three on arterial insufficiency ulcers.¹⁵

Heterogeneity in the definition of chronic wounds and the imbalance between the number of studies and the aetiological categorization of chronic wounds is compounded by the variability in study designs and approaches in assessing prevalence and incidence¹⁴ when attempting to arrive at an estimate of the 'global magnitude of the condition'. It is therefore emphasized that any estimates of the prevalence of chronic wounds have to be strongly caveated as a result of the limitations highlighted above. An additional problem with previous attempts to estimate the burden associated with the management of chronic wounds arises from the fact that many studies have been based on literature studies or estimates derived from incidence rates and extrapolations from relatively small samples.

Nevertheless, chronic wounds constitute a substantial human and economic burden at both an individual and a societal level, with relatively poor health-related quality of life in general, substantial costs associated with their management, and with an upward trajectory resulting from an ageing

population and earlier development of linked chronic illnesses, such as diabetes.¹⁶ An estimate from a relatively large study, based on a database of patient records, has suggested that the chronic wound prevalence in Wales was 6% in 2012–13, with costs corresponding to 5.5% of total NHS expenditure.¹⁷

To arrive at a more informed picture of chronic wound prevalence we explore the epidemiology of the various types of chronic wounds, as classified by their respective aetiology.

Venous leg ulcers

NHS England, in conjunction with the Academic Health Sciences Network, commissioned a National Wound Care Strategy, which aims to improve the prevention and care of PUs, lower limb ulcers and surgical wounds by reducing unnecessary variation, improving safety and optimizing patient experience and outcomes.¹⁸ In one of the reports relating to lower limb ulcers, the programme team highlights that 'the burden of chronic lower limb wound care is large and growing with significant and unwarranted variation in the use of evidence-based care'. The report estimated that in 2019 there were an estimated 739 000 leg ulcers in England, with estimated healthcare costs of £3.1 billion per annum, with wide variation in the quality of care provided, and with many people with leg ulcers not receiving effective evidence-based care that would increase healing rates and reduce recurrence. The programme argued that 'unless action is taken to improve care, the prevalence could grow by 4% per annum'.

Venous leg ulcers (VLUs) are a severe clinical manifestation of chronic venous insufficiency and are responsible for about 70% of chronic ulcers of the lower limbs.²⁰ However, chronic venous insufficiency is often not diagnosed until leg ulcers develop, at which stage treatment can be difficult and often leads to patients experiencing a repeated pattern of ulceration, healing and recurrence.²¹ Major risk factors include family history, obesity, deep venous thrombosis and increasing age.²² As stated earlier, prevalence varies due to different sampling methods, population ages and definitions of venous ulcers, but it has been estimated that VLUs affect up to 3% of the adult population worldwide²³ and increasing to 4% in the population aged > 65 years.²⁴ Most studies indicate a predominance of women affected, with female-to-male ratios ranging from 1.5 : 1 to 10 : 1.^{25,26}

VLUs are a major cause of morbidity and, as with all chronic wounds, have a large cost impact on healthcare systems, while their impact on labour markets and quality of life is also highly important.^{27–29} Lower limb venous ulceration represents the most advanced stage of chronic venous disorder, and is among the ten most common reasons for seeking medical care in Western countries.^{30,31}

Diabetic foot ulcers

The prevalence of diabetes is increasing³² and, within the next few years, it is projected that 5 million people in the UK will have diabetes, where the risk of foot problems is highly

significant, either because of diabetic neuropathy or peripheral arterial disease, or both.³³

It is estimated that 10% of people with diabetes will have a diabetic foot ulcer at some point in their lives. A foot ulcer has been defined as a localized injury to the skin and/or underlying tissue, below the ankle, in a person with diabetes. Diabetes is also the most common cause of nontraumatic limb amputation, with diabetic foot ulcers preceding more than 80% of amputations in people with diabetes. After a first amputation, people with diabetes are twice as likely to have a subsequent amputation as people without diabetes. Mortality rates after diabetic foot ulceration and amputation are high, with up to 70% of people dying within 5 years of having an amputation and around 50% dying within 5 years of developing a diabetic foot ulcer.

A systematic review and meta-analysis revealed global diabetic foot ulcer prevalence was 6.3% [95% confidence interval (CI) 5.4–7.3]; it was higher in men (4.5%, 95% CI 3.7–5.2) than in women (3.5%, 95% CI 2.8–4.2), and higher in patients with type 2 diabetes (6.4%, 95% CI 4.6–8.1) than those with type 1 diabetes (5.5%, 95% CI 3.2–7.7). In terms of geography, North America had the highest prevalence (13.0%, 95% CI 10.0–15.9), Oceania had the lowest (3.0%, 95% CI 0.9–5.0), while the prevalence in Asia, Europe and Africa was 5.5% (95% CI 4.6–6.4), 5.1% (95% CI 4.1–6.0) and 7.2% (95% CI 5.1–9.3), respectively. Australia has the lowest (1.5%, 95% CI 0.7–2.4) and Belgium the highest prevalence (16.6%, 95% CI 10.7–22.4), followed by Canada (14.8%, 95% CI 9.4–20.1) and the USA (13.0%, 95% CI 8.3–17.7). Patients with diabetic foot ulcer tended to be of older age, had a lower body mass index and longer duration of diabetes, alongside more frequent hypertension, diabetic retinopathy and smoking history than patients without diabetic foot ulceration.³⁴ The annual incidence of diabetic foot ulcer or necrosis in patients with diabetes is known to be about 2–5% and the lifetime risk ranges from 15% to 20%.^{35–37}

Pressure ulcers

A PU is a localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear.³⁸ The risk of developing a PU is increased in patients with activity and mobility impairment, due to their inability to reposition themselves, leaving them exposed to prolonged, unrelieved pressure/shear over bony prominences.^{39,40} PUs are generally considered a nursing-sensitive outcome and used as a quality indicator worldwide, providing a benchmark for evaluating care in various settings at all levels.⁴¹

Though preventable in most cases and with evidence-based guidelines available to prevent their occurrence,^{42,43} the prevalence of PUs has largely remained unchanged, while the associated costs of care continue to increase. PUs have a severe impact on the physical, emotional and social aspects of a patient's quality of life and present a major financial cost to health services, due to necessary intensive treatments and

increased length of stay. Prevalence tends to be higher in older age groups⁴⁴ and care settings where patient mobility is compromised.⁴⁵

A systematic review of 79 studies demonstrated that the prevalence of PUs across Europe was 10.8%, with results varying from 4.6% to 27.2% across countries. Almost 35% of the PUs were category I (the least severe), and the sacrum was the most common site for PUs to develop.³⁹ Other prevalence studies have produced a wide range of estimates for PUs both within and across care settings.^{44–50} For example, a systematic review of studies in intensive care settings produced estimates of between 4% in Denmark and 49% in Germany.⁵⁰ While the studies can be challenged on methodological grounds, the clear message is that more needs to be done to inform management of PUs in all care settings to avoid their occurrence and, where prevalent on patient transfer from one care setting to another, to initiate appropriate treatment to minimize risk of moving towards a more severe category of PU. The prevalence of chronic wounds in general warrants their management being afforded a greater priority and focus, supplemented by the significant economic implications associated with them, and to which further consideration is now given.

Economic costs of wounds

The economic costs of chronic wounds can be characterized by a 'cost of illness' approach.⁵¹ This is different from other economic techniques that directly address decision-making in the face of scarce resources such as cost–benefit analysis and cost-effectiveness analysis, with the latter used to maximize health benefits, measured in quality-adjusted life years (QALYS), from a fixed health services budget.⁵²

The 'cost of illness' or the 'burden of disease' approach includes multiple aspects of the condition and the impact on health outcomes for say a country, a region or the individuals and families affected. Estimates can arise from data on the incidence and prevalence of the disease. When new cases are added to a prevalent pool at a rate that exceeds cure or death, then prevalence-based studies will exceed the costs arising from consideration of only incident cases. Cost items are often included in cost-of-illness studies that exceed the scope of cost–benefit analysis and cost-effectiveness analyses, such as all direct and indirect expenditures incurred by health services, related care providing agencies, patients and families and losses to economic production. Cost-of-illness studies also include premature death, disability and impacts on health-related quality of life.

A recent systematic review published by Olsson et al.¹⁶ identifies that acquisition of a chronic wound has devastating consequences for patients, and contributes major costs to healthcare systems and societies. To explore this topic, the authors searched databases for articles published between 2000 and 2015 that reported cost outcomes for adults aged ≥ 18 years, with a wound chronicity ≥ 3 weeks and/or a wound identified as chronic, complex, hard-to-heal or having

led to amputation. Over 5000 identified abstracts were whittled down to 30 studies for data extraction.

Twenty of the studies report data that describe the health-related outcomes from leg ulcer,^{53–62} diabetes amputation^{62–69} and ulcers of mixed aetiologies.^{70,71} Health-related quality of life was worse for patients with chronic wounds as compared with those without. Health outcomes were found to be comparable with those of chronic obstructive pulmonary disease and cardiovascular diseases. This aspect of the burden was reported to be the 'worst' by patients whose mobility and mental health outcomes were severely compromised. There were no findings about informal carers or family members, but it is reasonable to imagine cost burdens extend to these groups.

Eleven of the studies report costs in financial terms and these were incurred by healthcare providers for leg ulcer,^{72–76} PU,⁷⁶ ulcers of mixed aetiologies,⁷⁷ diabetes amputation^{64,68,73,78,79} and nondiabetes amputation.⁷⁹ The largest cost burdens at the patient level were for diabetes-related amputations that required extended durations of inpatient care followed by rehabilitation in the community setting. The median cost per hospital stay was reported to be in a range between US\$12 851 and \$16 267. This exceeds the costs of an admission to treat heart failure. Costs for leg ulcers were found to be lower as patients relied more on community-based services.

A modelling study¹⁵ used data from 69 published papers to make cost estimates for the Australian setting.⁸⁰ The authors reported that chronic wounds impose large costs on health services. In aggregate, these were annually US\$1 654 591 697 for pressure injury, \$249 670 635 for diabetic ulcer, \$802 550 013 for venous ulcer and \$143 729 304 for arterial insufficiency ulcer. The total cost was \$2.85 billion per year, which is 2% of the total health spend by government in Australia. The majority of the costs are incurred for treatment of pressure injury in the acute hospital system. System level costs are reported for the NHS, with 2–3% of the total national health expenditure⁸¹ used for chronic wounds. The costs in the European population were 2% of the European health budget, with Scandinavian countries using 2–4% of the total healthcare expenditure for chronic wounds.⁸²

Further relevant work described a typical clinical commissioning group in the NHS. There are 136 of these in the NHS: on average each would be managing 11 200 wounds at any point in time⁸³ with 40% acute and 48% chronic wounds. The cost burden of chronic wounds on the NHS was estimated at £2870 per patient. The analyses presented showed that the current rate of wound healing must increase by at least 1% each year to slow the rise of prevalent cases. Identifying and implementing cost-effective interventions must be a strong priority for health service communities.

Cost-effectiveness of interventions

Another systematic review⁸⁴ addressed published cost-effectiveness studies that inform decision-making about how to reduce the problem, given scarce resources. The authors

included research that reported the 'change to costs' and 'health outcomes' from implementing evidence-based guidelines as a bundle of care for the prevention and treatment of chronic wounds. Twenty-four economic evaluation studies were included. Seven were about programmes to reduce diabetic foot ulcers,^{85–91} eight were about reducing pressure injuries,^{92–98} four described programmes to reduce venous leg ulcers^{98–101} and five dealt with ulcers of mixed aetiologies.^{102–106}

Twelve of the studies reported the development and evaluation of cost-effectiveness models^{85–89,91,93–96,99,102} with the primary outcomes of change to health benefits, expressed by QALYs.¹⁰⁷ Modelling studies are a powerful way of augmenting data from clinical trials with economic parameters for the purpose of making a decision about expected changes to efficiency from the adoption of a new practice or technology.¹⁰⁸ The 12 remaining studies were a mixture of cohort analyses and retrospective data audit,^{90,101,102,104} prospective cohort study and retrospective data audit,^{98,100} quasiexperimental pre/post study,^{105,109,110} cluster randomized trial^{97,106} and a prevalence and incidence study.⁹²

From the seven studies about diabetic foot ulcers, five^{85,90,91,97,111} found the application of guideline-based care to be cost saving or cost-effective. These studies were deemed robust, and uncertainties in the findings were appropriately included. The other two studies^{88,89} found the intervention was not likely to be cost-effective. All of the eight studies about preventing pressure injuries^{92–98,109} were positive in their conclusions about cost-effectiveness and all four studies of interventions for venous leg ulcers found interventions concluded cost saving were likely to arise.^{99–101,110}

Another systematic review¹¹² of economic evaluations of guideline-based interventions for the prevention of chronic wounds reported trial-based and model-based studies. Six of these^{113–118} were not included by Cheng et al.⁸⁴ in the previous review as they did not meet one or more of the inclusion criteria: (i) Morrell et al.¹¹³ compared a leg ulcer clinic with home care led by a district nursing in a randomized controlled trial and found the cost per ulcer-free week to be £2.46; (ii) Ohura et al.¹¹⁴ analysed a prospective cohort, compared modern vs. traditional dressings with and without a standard wound management algorithm, and found reductions in pressure injury alongside cost savings; (iii) Gordon et al.¹¹⁵ analysed data from a small randomized trial of the Leg Club® model of care, and found at 6 months costs were lower and health outcomes were improved for the intervention group; (iv) Sanada et al.¹¹⁶ studied a prospective cohort where training and hospital reimbursement were offered, and saw cost savings and improved healing outcomes; (v) Pham et al.¹¹⁷ modelled the lifetime cost-effectiveness of implementing four quality improvement strategies to prevent pressure injury vs. standard of care and found all components cost-effective; and (vi) Barshes et al.¹¹⁸ estimated cost-effectiveness over 10 years of different strategies for patients' chronic limb ischaemia vs. local wound care and found bypass endovascular revisions returned a cost per QALY of \$47 738, bypass/surgical

revisions a cost per QALY of \$58 749, endovascular bypass for failure a cost per QALY of \$102 000 and purely endovascular a cost per QALY of \$121 000.

Barriers to adoption of better services

We have summarized a situation where the problem of chronic wounds is prevalent and costly, yet prevention efforts appear to make economic sense. So, what of barriers to making changes that will likely improve patient outcomes?

Norman et al.¹¹⁹ define the current situation in Australia as one where a patient with an undiagnosed wound follows a path of self-management, delayed diagnosis, risk of infection, hospital admission, and risk of poor outcomes including infection and/or amputation. A patient whose wound is diagnosed and assessed relatively early faces a multitude of uncoordinated and overlapping services including allied health professionals, specialist wound clinics, community nurses, general practitioners, aged care workers, community pharmacists and medical specialists. These services are characterized by high initial treatment costs, especially for dedicated wound clinics, and where services are funded there is inadequate reimbursement to practitioners for them to prioritize wound care services. Further barriers arise from a lack of sustained investment in education and training, opening up a gulf between routine and gold standard practice.

Some qualitative research about the barriers to improving services was conducted by interviewing key stakeholders from the Australian setting.¹²⁰ They report a lack of awareness of the impact of chronic wounds, insufficient communication and liaison among healthcare providers, poor access to evidence-based wound management practices, insufficient education and training for service providers, and lack of reimbursement for services and consumables to patients and providers.

A commentary related to the NHS provided insights into the educational barriers to implementing gold standard care for chronic wounds.¹²¹ Relevant issues are: (i) the pace at which wound management has changed and the associated adoption of new technologies, with a risk of clinicians being overwhelmed with too much information; and (ii) the variable quality of the evidence, with few interventions being rigorously assessed by randomized designs.¹²² Clinicians would benefit from having stronger critical appraisal skills when confronted with a large and diverse evidence base.

Conclusions

The prevalence and healthcare expenditures associated with chronic wounds are sizeable and increasing, and highlight a necessity for action in their management. The need to prevent chronicity by improving healing rates and times through innovation and high quality research is clearly evident, while the obstacles and barriers that inhibit the move towards gold standard treatments and care should be addressed as a matter of urgency.

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